TITLE: Analysis Utilizing Solar Ultraviolet (UV-B) Radiation Data from the EPA Solar Ultraviolet Radiation Monitoring Network

PERIOD OF PERFORMANCE: April 30, 2004 until April 29, 2005

CONTRACT TYPE: New, Competitively Awarded

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1. BACKGROUND:

Under the direction of the U.S. Environmental Protection Agency (EPA), Office of Research and Development (ORD), National Exposure Research Laboratory (NERL), the EPA Solar Ultraviolet Radiation Monitoring Program operates and maintains a nationwide UV-B monitoring network in cooperation with the National Park Service (NPS) under an Interagency Agreement (DW14939466-0 1). This network currently employs a particular type of instrument known as the Brewer Spectrophotometer, manufactured by Kipp and Zonen (formerly SCI-TEC Instruments) in Saskatoon, Saskatchewan (Canada).

The government owns and operates the solar ultraviolet radiation monitoring network of Brewer Spectrophotometers and associated computers, monitors, modems, and printers. The EPA's solar UV-B radiation monitoring network consists of 21 sites located around the United States (including Alaska, Hawaii and the U.S. Virgin Islands) in 14 National Parks and 7 urban areas around the United States. All 21 sites have operational Brewer Spectrophotometers. These Brewers are located at the 21 sites shown in Appendix A.

The 21 Brewers operating in this EPA/NPS cooperative network measure UV-B radiation, total column ozone (not yet calibrated for this measurement), total column sulfur dioxide, optical density of the atmosphere, and other factors from which the stratospheric ozone profile can be derived. The customers for the UV-B data obtained from this network are ORD, NPS, the National Weather Service (NWS), EPA's Office of Air and Radiation (OAR), and scientists

doing ecological research, health effects assessment research, and atmospheric radiation research. The UV-B data is publically available through the EPA's UVNET website http://www.epa.gov/uvnet/access.html . Currently all Brewers in the network are calibrated annually against 1000 watt National Institute for Standards and Technology (NIST) traceable standard lamps.

The Brewer Spectrophotometer operational configuration includes a computer to collect the UV-B data and a telephone connection which facilitates data retrieval. A site operator is assigned at each site to perform routine duties related to Brewer operation. All site operators are supplied and funded by EPA or NPS under separate agreements. Many of the sites are in remote locations of the National Parks. Most of the National Park Service sites and many of the urban Brewer sites have air pollution monitors (e.g. ozone, PM, nephelometers, etc.) co-located with them.

2. SCOPE:

The contractor shall provide or obtain the necessary personnel, equipment, facilities, data and/or data sources (e.g., National Weather Service, TOMS, National Science Foundation, United States Department of Agriculture, etc.) required to perform analysis utilizing the UV-B data collected from the 21 Brewer sites. The final output from the contractor shall be a report detailing the findings listed for analysis tasks (a) through (m) given in Section 3 (consisting of a separate sub report for each analysis task (a) through (m) along with a minimum of one associated peer-reviewed journal article documenting the results of the various analyses. If the UV-B data utilized from the 21 Brewer Spectrophotometers and/or data utilized from other data sources (e.g., TOMS, National Weather Service, etc.) is insufficient to support any of the analyses listed in (a) through (m) given in Section 3, the contractor shall explain the nature of the insufficiency in the appropriate report(s) along with suggested methods to complete the particular analysis task(s).

3. TASK DESCRIPTIONS:

3.1 Analysis Utilizing Brewer Spectrophotometer UV-B Data

As a minimum, the contractor shall perform analyses, including mathematical/statistical analyses, utilizing the Brewer Spectrophotometer UV-B data obtained from the 21 Brewer sites which accomplishes the 13 data analysis tasks listed in (a) through (m) defined below. The contractor is free to use any supportable mathematical/statistical methods, data analysis methods, hypotheses/theories etc., in order to complete the data analysis tasks utilizing the UV-B data.

The contractor must utilize the UV-B data obtained from the 21 Brewer Spectrophotometer sites in the network to perform the following data analysis tasks:
(a) determine the trends in UV-B flux at the individual Brewer sites, at groups of similar sites, and/or across the network;

(b) analyze the factors affecting the observations and trends at each site (and across the network, as appropriate) including correlations with changes in the ozone column, changes in stratospheric ozone, changes in ground level ozone, changes attributable to other pollutants or atmospheric constituents, etc.;

(c) analyze the major factors affecting the UV-B flux, including solar angle, latitude, elevation, cloud cover, pollution levels and composition, etc.;

(d) analyze the direct versus indirect exposures to UV-B radiation and the factors affecting the ratio;

(e) compare the UV-B flux measurements with the predictions of the National Weather Service Ozone Watch Program, together with an analysis of the differences and potential causes for the discrepancies;

(f) compare the Brewer UV-B measurements with that of the Tropospheric Ultraviolet (TUV) Model, Total Ozone Mapping Satellite (TOMS) measurements, and provide an analysis of the differences of those measurements and the causes of those differences;

(g) compare the UV-B measurements with air pollution measurements to determine the effects of tropospheric air pollution on UV-B exposures;

(h) compare the trends in UV-B flux measured by the network at mid-latitudes in the United States to United Nations Environment Program (UNEP) data;

(i) determine the effect of clouds/haze/aerosols on UV-B exposure;

(j) analyze the directional diffuse (cloudless) sky irradiance in the 290nm - 325nm (UV-B) and 325nm - 400nm (UV-A) wavelength bands as a function of aerosol optical depth;

(k) analyze the directional diffuse sky irradiance in the 290nm - 400nm (UV-B and UV-A) wavelength band as a function of cloud cover, cloud type, cloud depth;

(l) analyze the reflectance (spectral albedo) for key materials (snow, beach sand, concrete, asphalt and water) in the 290nm - 400nm (UV-B and UV-A) wavelength band, as appropriate for the network measurement sites;

(m) analyze the bi-directional reflectance (forward-scattering and back-scattering) for key materials (snow, beach sand, concrete, asphalt and water) in the 290nm - 400nm (UV-B and UV-A) wavelength band, as appropriate for the network measurement sites.

4.0 DELIVERABLES:

4.1 Monthly Reports: The contractor shall provide a single interim monthly report on the status of the tasks listed in (a) through (m) above. The interim monthly report shall be a summary of the progress made/issues encountered for tasks (a) through (m). As a minimum, the interim monthly report shall consist of an e-mail to the EPA Project Officer detailing initial findings for and status of the analysis tasks (a) through (m). The contractor shall recommend the format for the interim monthly report to the EPA Project Officer for review/approval.

4.2 Final Report: The contractor shall provide a final report on the data analysis tasks (a) through (m) listed above. The contractor shall recommend the format for the final report to the EPA Project Officer for review/approval. The final output from the contractor shall be a report detailing the findings for analysis tasks (a) through (m) above along with a minimum of one associated peer-reviewed journal article documenting the results of the analyses. Any peer-reviewed journal article(s) resulting from this contract shall be submitted for publication/peer-review a minimum of 30 days before the end of this contract. The EPA Project Officer shall review the draft of any peer-reviewed journal article(s) resulting from this contract before they are submitted for publication/peer-review. The EPA Project Officer shall be notified by the contractor when any peer-reviewed journal article resulting from this contract is published in an issue of a peer-reviewed, scientific journal.

APPENDIX A

NATIONAL PARKS SITES and URBAN SITES

(1) Big Bend National Park, Texas
(2) Everglades National Park, Florida
(3) Virgin Islands National Park, Virgin Islands
(4) Sequoia National Park, California
(5) Rocky Mountain National Park, Colorado
(6) Smoky Mountains National Park, North Carolina
(7) Shenandoah National Park, Virginia
(8) Acadia National Park, Maine
(9) Denali National Park, Alaska
(10) Olympic National Park, Washington
(11) Glacier National Park, Montana
(12) Canyonlands National Park, Utah
(13) Theodore Roosevelt National Park, ND
(14) Hawaii Volcanoes National Park, Hawaii
(15) Chicago, IL
(16) Gaithersburg, MD
(17) Research Triangle Park, NC
(18) Atlanta, GA
(19) Boulder, CO
(20) Riverside, CA
(21) Albuquerque, NM